International Journal of General Medicine

Dovepress
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ORIGINAL RESEARCH

Interaction of Harmful Alcohol Use and Tea Consumption on Hyperuricemia Among Han Residents Aged 30–79 in Chongqing, China

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Objective: The prevalence of hyperuricemia appears to be high worldwide. We aimed to explore the interaction between harmful alcohol use and tea consumption on hyperuricemia.

Methods: This study recruited 22,449 Han residents based on the data from the China Multi-Ethnic Cohort (CMEC) study, Chongqing province, to have a face-to-face electronic questionnaire, physical examination, and clinical laboratory tests. The difference in hyperuricemia between the different populations was compared by the Chi-square test. The interaction between harmful alcohol use and tea consumption was analyzed by the multivariate logistic regression model.

Results: Amongst 22,449 participants, the mean age was 51.5±11.8 years, and 46.83% of them were males. The proportion of harmful alcohol use, tea consumption, and harmful alcohol use and tea consumption were 14.01%, 21.01%, and 6.54%, respectively. Multivariate logistic regression showed that the odds ratio (OR) of harmful alcohol use and tea consumption (OR=2.21, 95% CI: 1.58–3.10) was greater than that of harmful alcohol use (OR=1.63, 95% CI:1.17–2.27) and tea consumption (OR=1.34, 95% CI:1.10–1.63). Among males, the results were similar (harmful alcohol use and tea consumption: OR=2.02, 95% CI: 1.43–2.84; harmful alcohol use: OR=1.61, 95% CI: 1.14–2.27; tea consumption: OR=1.28, 95% CI: 1.05–1.57). However, among females, the odds ratio of harmful alcohol use and tea consumption (OR=15.50, 95% CI: 1.36–176.50) was more than 10 times than that of only harmful alcohol use (OR=1.55, 95% CI: 0.42–5.69) or tea consumption (OR=1.22, 95% CI: 0.52–2.82).

Conclusion: The interaction of harmful alcohol use and tea consumption was a positive risk for hyperuricemia in Han residents aged 30–79 years in China.

Keywords: hyperuricemia, tea consumption, harmful alcohol use, interaction, Han residents

Introduction

Hyperuricemia (HU), caused by aberrant metabolite of purine, occurring with exorbitant serum uric acid (SUA) levels, is currently prevailing across the world.[1,2] Potentially engendering gout, a common inflammatory arthritis, which results in swelling joint, sudden and severe pain, and possible disability, HU has been a threat to the life quality of people and global public health.[3] HU is often associated with several other diseases including cardiovascular diseases,[4] dyslipidemia,[5] diabetes,[6,7] hypertension,[6,8] chronic kidney disease,[9] metabolic syndrome[10] and liver dysfunction.[11,12] The prevalence of hyperuricemia appears to be high worldwide, which was 20.1% in the United States, 2016,[13] and 16.6% in South Australia.[14] According to the meta-analysis collected data between year 2000 and 2014, the prevalence in China ranged from 5.5% to 23.5% in various regions.[15]

The increasing prevalence of hyperuricemia is related to lifestyle and dietary habits.[16,17] Excessive alcohol consumption has been assumed to be positively associated with HU by increasing SUA level.[18,19] However, the association between tea consumption and HU would be expected to be negative by decreasing SUA level in the mice model.[20,21] Current evidence

Received: 17 December 2022
Accepted: 9 March 2023
Published: 17 March 2023

suggest that tea consumption does not seem to be associated with SUA level, HU or gout.[22] A recent study reflected that tea consumption was associated with the risk of hyperuricemia in an occupational population.[23] Yet, the epidemiological data that can prove such hypotheses about the association between consumption of tea or alcohol and HU are scarce. Furthermore, in the real world, the consumption of tea and alcohol consumption would not be independent, while the interaction between consumption of tea and harmful alcohol use on HU has not gained enough attention and remains unclear. Chongqing is the largest municipality in Southwestern China. Tea is also one of Chongqing's specialties. Tea consumption is popular among the residents of Chongqing. At the same time, tea consumption after alcohol use is generally believed to be beneficial to health. Therefore, based on the data from the China Multi-Ethnic Cohort (CMEC), Chongqing province, we aimed to investigate the interaction between harmful alcohol use and tea consumption on hyperuricemia.

Methods

Study Population

We gathered the data from the CMEC study, Chongqing province. Details of the cohort study design have been presented previously.[24] All participants in our study were randomly selected from thirteen districts/counties. The inclusion criteria we applied were as follows: 1) Han residents aged between 30 and 79 years on the day of the investigation; 2) live in the local area for half a year or more; 3) capable of completing the baseline survey and taking a blood sample; 4) voluntarily participating in the survey and signing informed consent; 5) having the normal ability of expression and understanding. Overall, a total of 23,308 individuals aged 30–79 were recruited at baseline. To explore the interaction between harmful alcohol use and tea drinking on hyperuricemia, a total of 859 subjects were excluded because of missing data on hyperuricemia. Ultimately, the study enrolled 22,449 individuals for the current analysis.

Assessment of Harmful Alcohol Use and Tea Consumption

The standardized questionnaire was used to collect general characteristics such as smoking, alcohol use, tea consumption, physical activity, dietary intake information, and family history of the disease. All participants were interviewed by well-trained staff through face-to-face interviews. Daily consumption of alcohol (grams of pure alcohol per day) was calculated based on the reported frequency and quantity of drinking. Harmful alcohol use was defined according to 61 grams of pure alcohol per day for male residents and 41 grams of pure alcohol per day for female residents.[25] Participants were asked, "Whether you drink tea every week lasting half a year".

Assessment of Covariates

A structured questionnaire was used to collect detailed information regarding sociodemographic characteristics and lifestyle factors. The following variables were explored in the current study: age, sex, educational level, marital status, annual family income, smoking status, physical activity, red meat intake, vegetables, and fruit intake, cooking oil, salt intake, spicy food, and hemp diet. 1) Participants' physical activity levels were classified as adequate or inadequate based on whether there were 150 minutes or more of moderate-intensity aerobic activity per week.[26] 2) Overtake of red meat is defined as eating more than 100 grams of red meat per person per day.[25] 3) Insufficient intake of vegetables and fruit was defined as eating less than 400 grams of vegetables and fruit per person per day.[25] 4) Overtake of cooking oil was defined as taking more than 30 grams of cooking oil per person per day.[25] 5) Overtake of salt was defined as taking more than 5 grams of salt per person per day.[25] 6) Socioeconomic status was classified as low, middle, or high according to education level, annual house income, and career.[27] 7) Family history of diabetes was defined as the history of diabetes among first-degree relatives such as parents, sisters/brothers, and sons/daughters.

Diagnostic Criteria of Hyperuricemia

Blood samples were collected from all participants via venipuncture after overnight fasting, then centrifuged and separated for later clinical laboratory testing. The serum uric acid (SUA) was analyzed by the standard enzyme method which was based on the generation of hydrogen peroxide from uric acid catalyzed by immobilized uricase and then determined by the color reaction catalyzed by immobilized peroxidase. The intra-assay coefficients of variation for SUA

were less than 6.5%. In the present study, we defined hyperuricemia as increased SUA above 6 mg/dl for women and 7 mg/dl for men and women according to Chinese experts' consensus on hyperuricemia and gout treatment (2016).[28]

Statistical Analysis

The general characteristics of study participants were described according to hyperuricemia (0 = No, 1 = Yes). Means and standard deviations were presented for continuous variables, while categorical variables were expressed as numbers and percentages. Analysis of chi-square tests was used to compare the differences in hyperuricemia between different socio-demographics and lifestyles. Multivariable-adjusted logistic regression models were conducted to investigate the interaction between harmful alcohol use and tea consumption on hyperuricemia. The results of the odds ratios (ORs) and 95% confidence intervals (CIs) were presented. A series of models were used to minimize the influence of confounding factors on this association. Model 1 was a crude model without any adjustments. Model 2 was adjusted for sex, age, socioeconomic status, and family history of diabetes. Model 3 was additionally adjusted for smoking, drinking beverage, physical activity, insufficient of vegetable and fruit intake, spicy food, and hemp diet. All statistical analyses were carried out using SPSS version 25.0. All statistical tests were two-sided, and a P value <0.05 was considered statistically significant.

Results

General Characteristics

Table 1 presents the general characteristics of the participants. A total of 22,449 residents were enrolled in this study. Their average age was 51.5±11.8 years. And 46.83% and 53.17% of them were male and female, respectively; 87.91% of them were married. High socioeconomic status accounted for 28.15%. Moreover, 7.76% of the participants had a family

Table 1 Hyperuricemia Prevalence Among Residents Aged Between 30 and 79 Years in Chongqing, China

Variables	Males No. (%)	Females No. (%)	Overall Participants No. (%)	Hyperuricemia Prevalence No. (%)	*P*
Socio-demographic characteristics					
Sex					<0.01
Male	-	-	10,512 (46.83)	2131 (20.27)	
Female	-	-	11,937 (53.17)	1105 (9.26)	
Age (Years)					<0.01
30–39	1752 (16.67)	2352 (19.70)	4104 (18.28)	646 (15.74)	
40–49	3327 (31.65)	4086 (34.23)	7413 (33.02)	950 (13.72)	
50–59	2376 (22.60)	2598 (21.76)	4974 (22.16)	716 (15.00)	
60–69	2153 (20.48)	2001 (16.77)	4154 (18.50)	607 (15.43)	
70–79	904 (8.60)	900 (7.54)	1804 (8.04)	317 (17.57)	
Marital status					0.050
Married or cohabit	9512 (90.49)	10,222 (85.63)	19,734 (87.91)	2811 (14.24)	
Single or divorced or widow	1000 (9.51)	1715 (14.37)	2715 (12.09)	425 (15.65)	
Socioeconomic status					<0.01
Low	2708 (25.76)	3032 (25.40)	5740 (25.57)	697 (12.14)	
Middle	4428 (42.12)	5961 (49.94)	10,389 (46.28)	1465 (14.10)	
High	3376 (32.12)	2944 (24.66)	6320 (28.15)	1074 (16.99)	
Family history of diabetes					0.035
No	9699 (92.27)	11,007 (92.21)	20,706 (92.24)	2955 (14.27)	
Yes	813 (7.73)	930 (7.79)	1743 (7.76)	281 (16.12)	
Health-related behavioral characteristics					
Smoking					<0.01
No	4660 (44.33)	11,762 (98.53)	16,422 (73.15)	2041 (12.43)	
Yes	5852 (55.67)	175 (1.47)	6027 (26.85)	1195 (19.83)	

(*Continued*)

Table 1 (Continued).

Variables	Males No. (%)	Females No. (%)	Overall Participants No. (%)	Hyperuricemia Prevalence No. (%)	*P*
Passive smoking					<0.01
No	5774 (54.93)	5716 (47.88)	11,490 (51.18)	1444 (13.18)	
Yes	4738 (45.07)	6221 (52.12)	10,959 (48.82)	1792 (15.60)	
Drinking beverage every week for half a year					<0.01
Yes	470 (4.47)	220 (1.84)	690 (3.07)	142 (20.58)	
No	10,042 (95.53)	11,717 (98.16)	21,759 (96.93)	3094 (14.22)	
Frequency of alcohol use in the past year					<0.01
Never	3073 (29.23)	7200 (60.32)	10,273 (45.76)	1232 (11.99)	
Seldom	4622 (43.97)	4393 (36.80)	9015 (40.16)	1292 (14.33)	
Always	2817 (26.80)	344 (2.88)	3161 (14.08)	712 (22.52)	
Harmful alcohol use[a]					0.001
No	2311 (85.09)	304 (93.54)	2615 (85.99)	566 (21.64)	
Yes	405 (14.91)	21 (6.46)	426 (14.01)	122 (28.64)	
Tea consumption					<0.01
No	7045 (67.02)	10,687 (89.53)	17,732 (78.99)	2260 (12.75)	
Yes	3467 (32.98)	1250 (10.47)	4717 (21.01)	976 (20.69)	
Gram of tea each time[b]					0.005
1–2	1099 (33.10)	653 (55.43)	1752 (38.95)	393 (18.83)	
3–4	786 (23.67)	255 (21.65)	1041 (23.14)	309 (20.93)	
≥5	1435 (43.22)	270 (22.92)	1705 (37.91)	272 (23.69)	
Physical activity					0.001
Insufficient	6240 (59.36)	6601 (55.30)	12,841 (57.20)	1762 (13.72)	
Sufficient	4272 (40.64)	5336 (44.70)	9608 (42.80)	1474 (15.34)	
Overtake of red meat					<0.01
No	7870 (74.87)	10,429 (87.37)	18,299 (81.51)	2556 (13.97)	
Yes	2642 (25.13)	1508 (12.63)	4150 (18.49)	680 (16.39)	
Insufficient intake of vegetable and fruit					0.008
No	5449 (51.84)	7205 (60.36)	12,654 (56.37)	1755 (13.87)	
Yes	5063 (48.16)	4732 (39.64)	9795 (43.63)	1481 (15.12)	
Overtake of cooking oil				0.650	
No	1840 (17.50)	2066 (17.31)	3906 (17.40)	554 (14.18)	
Yes	8672 (82.50)	9871 (82.69)	18,543 (82.60)	2682 (14.46)	
Overtake of salt					0.031
No	3920 (37.29)	4613 (38.64)	8533 (38.01)	1285 (15.06)	
Yes	6592 (62.71)	7324 (61.36)	13,916 (61.99)	1951 (14.02)	
Habit of spicy food					<0.01
No	2384 (22.68)	3018 (25.28)	5402 (24.06)	685 (12.68)	
Yes	8128 (77.32)	8919 (74.72)	17,047 (75.94)	2551 (14.96)	
Habit of the hemp diet					<0.01
No	2889 (27.48)	3922 (32.86)	6811 (30.34)	845 (12.41)	
Yes	7623 (72.52)	8015 (67.14)	15,638 (69.66)	2391 (15.29)	
Harmful alcohol use and tea consumption[b]					<0.01
No harmful alcohol use and no tea consumption	1280 (47.13)	245 (75.38)	1525 (50.15)	296 (19.41)	
Harmful alcohol use and no tea consumption	209 (7.70)	18 (5.54)	227 (7.47)	59 (25.99)	
No harmful alcohol use and tea consumption	1031 (37.96)	59 (18.16)	1090 (18.84)	270 (24.77)	
Harmful alcohol use and tea consumption	196 (7.21)	3 (0.92)	199 (6.54)	63 (31.66)	

Notes: [a]Participants had a history of alcohol use. [b]Data missing.

history of diabetes. The proportion of smoking, passive smoking, harmful alcohol use, drinking beverage every week for half a year, insufficient physical activities, and tea consumption were respectively 26.85%, 48.82%, 14.01%, 3.07%, 57.20%, and 21.01%. The proportion of red meat overtake, insufficient intake of vegetables and fruits, overtake of cooking oil, and salt was 18.49%, 43.63%, 82.60%, and 61.99%, respectively. The proportion of the habit of spicy food and hemp diet was 75.94% and 69.66%. Among those who had a history of alcohol use, 6.54% of them had a history of harmful alcohol use and tea consumption. The proportion of harmful alcohol and tea consumption was 14.91% and 32.98% for men and 6.46% and 10.47% for women, respectively.

Prevalence of Hyperuricemia

The prevalence of hyperuricemia among residents aged between 30 and 79 years was 14.41% and was higher in males (20.27%) than that in females (9.26%) (χ^2=549.74, P<0.05). Table 1 presents the difference in hyperuricemia among the different populations. The prevalence of hyperuricemia among overall participants who had the history of harmful alcohol use (28.64%) and that of tea consumption (20.69%) were both higher than those who did not have the history of harmful alcohol use (21.64%) or tea consumption (12.75%), respectively (P<0.05). Moreover, the prevalence of hyperuricemia among overall participants who both had the history of harmful alcohol use and tea consumption (31.66%) was the highest (P<0.05).

The Interaction Between Harmful Alcohol Use and Tea Consumption

Table 2 presents the results of multivariate logistic regression. The results of the model 1 without adjusting covariate indicated that overall participants who had the history of harmful alcohol use (OR=1.46, 95% CI: 1.06–2.01), tea consumption (OR=1.37, 95% CI: 1.13–1.65), harmful alcohol use and tea consumption (OR=1.92, 95% CI:1.39–2.66) was vulnerable to hyperuricemia. Furthermore, model 3 after adjusting covariate variables reflected that harmful alcohol use, tea consumption, and harmful alcohol use and tea consumption were all the risk factors of hyperuricemia. Moreover, the odds ratio of harmful alcohol use and tea consumption (OR=2.21, 95% CI: 1.58–3.10) was greater than the odds ratio of harmful alcohol use (OR=1.63, 95% CI:1.17–2.27) or tea consumption (OR=1.34, 95% CI:1.10–1.63). Moreover, we performed multivariate regression analysis for men and women separately. The results of Model 3 after adjusting covariate variables indicated that males who had harmful alcohol use, tea consumption, and harmful alcohol use and tea consumption were all the risk factors of hyperuricemia. Furthermore, the odds ratio of harmful alcohol use and tea consumption (OR=2.02, 95% CI: 1.43–2.84) was greater than the odds ratio of harmful alcohol use (OR=1.61, 95% CI:1.14–2.27) or tea consumption (OR=1.28, 95% CI:1.05–1.57). Among females, the results in Model 3 indicated that

Table 2 Interaction of Tea Consumption and Harmful Alcohol Use on Hyperuricemia Among Han Residents Aged Between 30 and 79 Years in Chongqing Municipality, China

Model	Variables	Males		Females		Overall Participants	
		OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Model 1	No harmful alcohol use and no tea consumption	1.00		1.00		1.00	
	Harmful alcohol use but no tea consumption	1.38(0.99–1.93)	0.058	1.55(0.42–5.69)	0.509	1.46(1.06–2.01)	0.022
	No harmful alcohol use but tea consumption	1.29(1.06–1.56)	0.011	1.22(0.523–2.82)	0.650	1.37(1.13–1.65)	0.001
	Harmful alcohol use and tea consumption	1.71(1.23–2.38)	0.002	15.50(1.36–176.50)	0.027	1.92(1.39–2.66)	<0.001
Model 2	No harmful alcohol use and no tea consumption	1.00		1.00		1.00	
	Harmful alcohol use but no tea consumption	1.61(1.14–2.26)	0.007	1.55(0.42–5.69)	0.509	1.59(1.14–2.21)	0.006
	No harmful alcohol use but tea consumption	1.32(1.08–1.62)	0.007	1.22(0.52–2.82)	0.650	1.31(1.08–1.59)	0.007
	Harmful alcohol use and tea consumption	2.04(1.45–2.88)	<0.001	15.50(1.36–176.50)	0.027	2.09(1.49–2.92)	<0.001
Model 3	No harmful alcohol use and no tea consumption	1.00		1.00		1.00	
	Harmful alcohol use but no tea consumption	1.61(1.14–2.27)	0.006	1.55(0.42–5.69)	0.509	1.63(1.17–2.27)	0.004
	No harmful alcohol use but tea consumption	1.28(1.05–1.57)	0.016	1.22(0.52–2.82)	0.650	1.34(1.10–1.63)	0.003
	Harmful alcohol use and tea consumption	2.02(1.43–2.84)	<0.001	15.50(1.36–176.50)	0.027	2.21(1.58–3.10)	<0.001

Notes: Model 1: unadjusted model. Model 2: adjusted for sex, age, socioeconomic status, and family history of diabetes. Model 3: additionally adjusted for smoking, drinking beverage, physical activity, insufficient of vegetable and fruit intake, spicy food, and hemp diet.

harmful alcohol use and tea consumption were the risk factors of hyperuricemia, and the odds ratio of harmful alcohol use and tea consumption (OR=15.50, 95% CI:1.36–176.50) was more than 10 times of those who had only harmful alcohol use (OR=1.55, 95% CI:0.42–5.69) or tea consumption (OR=1.22, 95% CI:0.52–2.82).

Discussion

This study is the largest population study to explore the interaction of harmful alcohol use and tea consumption on hyperuricemia in Chongqing, China. The prevalence of hyperuricemia was high in Chongqing, China. Males had more risk of hyperuricemia than that in females. Tea consumption and harmful alcohol use were both risk factors for hyperuricemia. Moreover, the interaction of harmful alcohol use and tea consumption increased the risk of hyperuricemia for males, females, and overall participants in Chongqing.

The prevalence of hyperuricemia among residents aged between 30 and 79 years was 14.41%. In the same period, the prevalence of hyperuricemia among Tibetan residents aged between 30 and 79 years was 22.68% in Lhasa Prefecture, China.[29] The prevalence of hyperuricemia in another cohort study of Zhuang nationality was 29.6% in Guangxi, China.[30] The prevalence of hyperuricemia among residents aged between 30 and 79 years was 16.11% in another cohort study in Northeast China.[31] The prevalence of hyperuricemia was 9.3% among staffs in Bangladesh.[32] This difference of hyperuricemia prevalence was due to different lifestyles. The prevalence of hyperuricemia in males was higher than that in females. This finding was proved in previous studies in China.[29–31] The prevalence of hyperuricemia was 16.6% in men and 5.8% in women respectively in Japan, 2011.[33] The high prevalence of hyperuricemia among male residents was due to more risk factors of hyperuricemia such as alcohol use, tea consumption, smoking, and unhealthy diet habits.[15,16,34]

Previous studies showed that alcohol consumption was associated with the risk of hyperuricemia.[35–37] Some studies revealed that heavy alcohol consumption was a risk of hyperuricemia in men.[18,19,38] These findings were consistent with our results that harmful alcohol use was the risk factor of hyperuricemia for males, females, and overall participants. Purine nucleotide degradation during ethanol catabolism, inhibition of renal excretion of urate by lactic acid, and high purine content of certain kinds of beverages and diet are responsible for the elevation of serum uric acid levels following alcohol drinking.[39] However, harmful alcohol consumption was not a risk of hyperuricemia in women in our study. It may be related to the low proportion of Chinese women who have a history of drinking, especially the lower proportion of harmful drinking.[40]

Our study revealed that tea consumption was the risk factor of hyperuricemia for men and overall participants, which was consistent with previous studies.[22,40] There are three possible explanations for this finding. First, catechins reversely regulate the expression of organic anion transporter 1,[42] a secreting protein for uric acid excretion, which could account for the increase in SUA.[43] Second, some overlooked substances in tea might increase the SUA level, and overconsumption of tea could have harmful effects. Third, the health status of the study participants could have influenced their SUA levels.[23] Previous studies have demonstrated associations between hyperuricemia and cardiovascular disease, renal disease, diabetes, hypertension, and other diseases.[4] The mechanism of the effect of tea consumption on hyperuricemia requires further research.

The odds ratio of participants who also had the history of harmful alcohol use and tea consumption was higher than that who had the history of harmful alcohol use or tea consumption after adjusting all covariate variables. This finding proved the positive interaction of harmful alcohol use and tea consumption on hyperuricemia for males, females and overall participants. There are two possible explanations. First, harmful drinking increases the production of uric acid and inhibits the excretion of uric acid.[39,44] Secondly, harmful alcohol use causes acute liver damage, which affects the production of uric acid metabolic enzymes and uric acid transporters. One study indicated xanthine oxidase inhibition could reduce uric acid production. Nrf2 activation and urate transporters regulation could increase uric acid excretion.[41] Some overlooked substances in tea might increase the SUA level, and overconsumption of tea could have harmful effects.[23] Especially, overconsumption of tea may further accelerate the production of uric acid and reduce the excretion of uric acid after harmful alcohol use. The interaction of harmful alcohol use and tea consumption on hyperuricemia among female residents was greater than that among male residents.

Strengths and Limitations

This study is the first large population study in Chongqing, China. It is also the first study to explore the interaction between harmful alcohol use and tea consumption in Southwest China. However, four limitations should also be considered. Firstly, as a cross-sectional survey, we could not prove the causal association between tea consumption, harmful alcohol use, or the interaction of tea consumption and harmful alcohol use and hyperuricemia. Cohort studies of large population will be needed to verify the causal effect. Secondly, the information of alcohol use and tea consumption was self-reported, which might have reporting bias and recall bias. Further research will illustrate the mechanism of the interaction between tea consumption and harmful alcohol use on hyperuricemia. Thirdly, all the individuals participated in the current study voluntarily. Participants were more likely to have high educational levels and healthy lifestyles, which may lead to an underestimate of the prevalence of various diseases. Fourthly, variables such as ejection fraction, creatinine, or glomerular filtration rate had not been collected. Blood pressure, blood glucose, and blood lipid were not included in the analysis model due to greater consideration of lifestyle effects.

Conclusion

This study revealed that the prevalence of hyperuricemia among Han residents aged 30–79 years was high in Chongqing, China. Tea consumption and harmful alcohol use were both the risk factors of hyperuricemia among Han residents aged 30–79 years. The interaction of harmful alcohol use and tea consumption was a positive risk of hyperuricemia among males and females and in overall participants aged 30–79 years in Chongqing, China. This finding will be demonstrated in further prospective research.

Abbreviations

HU, hyperuricemia; SUA, serum uric acid; CMEC, China Multi-Ethnic Cohort; OR, odds ratios; CI, confidence interval.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval and Informed Consent

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research Ethics Committee of the Chongqing Centre for Disease Control and Prevention (No. 2017 (001)). All study participants provided informed consent. All methods were performed in accordance with the relevant guidelines and regulations.

Acknowledgments

We really appreciate all the participants in this study, and thanks for the support of all the team members for this study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This work was supported by the National Key R&D Program of China (grant number: 2017YFC0907303).

Disclosure

The authors declare that they have no competing interests in this work.

References

1. Li Q, Li X, Wang J, et al. Diagnosis and treatment for hyperuricemia and gout: a systematic review of clinical practice guidelines and consensus statements. *BMJ Open*. 2019;9(8):e026677. PMID: 31446403; PMCID: PMC6720466. doi:10.1136/bmjopen-2018-026677
2. Smith E, March L. Global prevalence of hyperuricemia: a systematic review of population-based epidemiological studies. *Arthrit Rheumatol*. 2015;67:2690–2692.
3. Dehlin M, Jacobsson L, Roddy E. Global epidemiology of gout: prevalence, incidence, treatment patterns and risk factors. *Nat Rev Rheumatol*. 2020;16(7):380–390. PMID: 32541923. doi:10.1038/s41584-020-0441-1
4. Zhang S, Wang Y, Cheng J, et al. Hyperuricemia and cardiovascular disease. *Curr Pharm Des*. 2019;25(6):700–709. PMID: 30961478. doi:10.2174/1381612825666190408122557
5. Ali N, Rahman S, Islam S, et al. The relationship between serum uric acid and lipid profile in Bangladeshi adults. *BMC Cardiovasc Disord*. 2019;19 (1):42. PMID: 30791868; PMCID: PMC6385393. doi:10.1186/s12872-019-1026-2
6. Mortada I. Hyperuricemia, type 2 diabetes mellitus, and hypertension: an emerging association. *Curr Hypertens Rep*. 2017;19(9):69. PMID: 28770533. doi:10.1007/s11906-017-0770-x
7. Haque T, Rahman S, Islam S, et al. Assessment of the relationship between serum uric acid and glucose levels in healthy, prediabetic and diabetic individuals. *Diabetol Metab Syndr*. 2019;11:49. doi:10.1186/s13098-019-0446-6
8. Ali N, Mahmood S, Islam F, et al. Relationship between serum uric acid and hypertension: a cross-sectional study in Bangladeshi adults. *Sci Rep*. 2019;9(1):9061. doi:10.1038/s41598-019-45680-4
9. Johnson RJ, Sanchez Lozada LG, Lanaspa MA, et al. Uric acid and chronic kidney disease: still more to do. *Kidney Int Rep*. 2022;8(2):229–239. PMID: 36815099; PMCID: PMC9939362. doi:10.1016/j.ekir.2022.11.016
10. Lekpa FK, Bebey FS, Bouallo I, et al. Gender difference in the association between gout at diagnosis and metabolic syndrome in African population: a retrospective cohort study. *Pan Afr Med J*. 2022;43:164. PMID: 36825121; PMCID: PMC9941612. doi:10.11604/pamj.2022.43.164.37197
11. Molla NH, Kathak RR, Sumon AH, et al. Assessment of the relationship between serum uric acid levels and liver enzymes activity in Bangladeshi adults. *Sci Rep*. 2021;11(1):20114. PMID: 34635716; PMCID: PMC8505549. doi:10.1038/s41598-021-99623-z
12. Yang C, Yang S, Feng C, et al. Associations of hyperuricemia and obesity with remission of nonalcoholic fatty liver disease among Chinese men: a retrospective cohort study. *PLoS One*. 2018;13(2):e0192396. PMID: 29415050; PMCID: PMC5802898. doi:10.1371/journal.pone.0192396
13. Chen XM, Yokose C, Rai SK, et al. Contemporary prevalence of gout and hyperuricemia in the United States and decadal trends: the national health and nutrition examination survey, 2007–2016. *Arthrit Rheumatol*. 2019;71(6):991–999. PMID: 30618180; PMCID: PMC6536335. doi:10.1002/art.40807
14. Ting K, Gill TK, Keen H, Tucker GR, Hill CL. Prevalence and associations of gout and hyperuricemia: results from an Australian population-based study. *Intern Med J*. 2016;46(5):566–573. PMID: 26765205. doi:10.1111/imj.13006
15. Liu R, Han C, Wu D, et al. Prevalence of hyperuricemia and gout in Mainland China from 2000 to 2014: a systematic review and meta-analysis. *Biomed Res Int*. 2015;2015:762820. PMID:26640795; PMCID: PMC4657091. doi:10.1155/2015/762820
16. Choi HK, McCormick N, Lu N, et al. Population Impact Attributable to Modifiable Risk Factors for Hyperuricemia. *Arthrit Rheumatol*. 2020;72 (1):157–165. PMID: 31486212; PMCID: PMC6935419. doi:10.1002/art.41067
17. Liu L, Lou S, Xu K, et al. Relationship between lifestyle choices and hyperuricemia in Chinese men and women. *Clin Rheumatol*. 2013;32 (2):233–239. PMID: 23132661. doi:10.1007/s10067-012-2108-z
18. Jee YH, Jung KJ, Park YB, et al. Causal effect of alcohol consumption on hyperuricemia using a Mendelian randomization design. *Int J Rheum Dis*. 2019;22(10):1912–1919. PMID: 31338989. doi:10.1111/1756-185X.13668
19. Li Z, Guo X, Liu Y, et al. The Relation of moderate alcohol consumption to hyperuricemia in a rural general population. *Int J Environ Res Public Health*. 2016;13(7):732. PMID: 27447659; PMCID: PMC4962273. doi:10.3390/ijerph13070732
20. Jung MH, Seong PN, Kim MH, et al. Effect of green tea extract microencapsulation on hypertriglyceridemia and cardiovascular tissues in high fructose-fed rats. *Nutr Res Pract*. 2013;7(5):366–372. PMID: 24133615; PMCID: PMC3796661. doi:10.4162/nrp.2013.7.5.366
21. Chen G, Tan ML, Li KK, et al. Green tea polyphenols decreases uric acid level through xanthine oxidase and renal urate transporters in hyperuricemia mice. *J Ethnopharmacol*. 2015;175:14–20. PMID: 26344851. doi:10.1016/j.jep.2015.08.043
22. Zhang Y, Cui Y, Li XA, et al. Is tea consumption associated with the serum uric acid level, hyperuricemia or the risk of gout? A systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2017;18(1):95. PMID: 28245834; PMCID: PMC5331744. doi:10.1186/s12891-017-1456-x
23. Li R, Zeng L, Wu C, et al. Tea consumption is associated with an increased risk of hyperuricemia in an occupational population in Guangdong, China. *Int J Gen Med*. 2022;15:2747–2757. PMID: 35300131; PMCID: PMC8922363. doi:10.2147/IJGM.S355253
24. Zhao X, Hong F, Yin J, et al. Cohort profile: the China Multi-Ethnic cohort (CMEC) study. *Int J Epidemiol*. 2021;50(3):721. doi:10.1093/ije/dyaa185
25. Chinese society for nutrition. *Popular Science Edition of Dietary Guidelines for Chinese Residents (2022)*. Beijing: People's Medical Publishing House; 2022:5–115.
26. Piercy KL, Troiano RP, Ballard RM, et al. The physical activity guidelines for Americans. *JAMA*. 2018;320(19):2020–2028. doi:10.1001/jama.2018.14854
27. Xu XD, Jiang GH, Song GD, et al. Impact on healthy behavior of socioeconomic status among residents in Tianjin. *Chin J Prev Contr Chron Dis*. 2019;27(5):360–363. doi:10.16386/j.cjpccd.issn.1004-6194.2019.05.010
28. Chinese Society of Endocrinology, Chinese Medical Association. Chinese experts consensus on hyperuricemia and gout treatment. *Chin J Endocrinol Metab*. 2013;29(11):913–920. Doi:10.3760/cma.j.issn.1000-6699.2013.11.001
29. Qiang B, Chen L, Qiong L, et al. Association between drinking behavior and hyperuricemia of the Zang people in Lhasa of China: based on the weighting method of propensity score. *Soft Sci Health*. 2022;36(01):91–96.
30. Tang XF, Chou XQ, Zheng XY, et al. The prevalence and risk factors of hyperuricemia in Guangxi Zhuang minorities residents aged of 35–74 years. *J Guangxi Med Univ*. 2021;38(3):583–590. doi:10.16190/j.cnki.45-1211/r.2021.03.028
31. Sun H. *Relationship Between Dietary Fiber Intake and Hyperuricemia in Residents of Northeast China*. Shenyang: China Medical University; 2021:1–56.

32. Ali N, Perveen R, Rahman S, et al. Prevalence of hyperuricemia and the relationship between serum uric acid and obesity: a study on Bangladeshi adults. *PLoS One*. 2018;13(11):e0206850. PMID: 30383816; PMCID: PMC6211757. doi:10.1371/journal.pone.0206850
33. Honda K, Okazaki K, Tanaka K, et al. Evacuation after the Great East Japan Earthquake is an independent factor associated with hyperuricemia: the Fukushima Health Management Survey. *Nutr Metab Cardiovasc Dis*. 2021;31(4):1177–1188. PMID: 33549460. doi:10.1016/j.numecd.2020.12.016
34. Yang T, Zhang Y, Wei J, et al. Relationship between cigarette smoking and hyperuricemia in middle-aged and elderly population: a cross-sectional study. *Rheumatol Int*. 2017;37(1):131–136. doi:10.1007/s00296-016-3574-4
35. Beyl RN, Hughes L, Morgan S. Update on importance of diet in gout. *Am J Med*. 2016;129(11):1153–1158. doi:10.1016/j.amjmed.2016.06.040
36. Nieradko-Iwanicka B. The role of alcohol consumption in pathogenesis of gout. *Crit Rev Food Sci Nutr*. 2021;19:1–9. doi:10.1080/10408398.2021.1911928
37. Li R, Yu K, Li C. Dietary factors and risk of gout and hyperuricemia: a meta-analysis and systematic review. *Asia Pac J Clin Nutr*. 2018;27(6):1344–1356. doi:10.6133/apjcn.201811_27(6).0022
38. Makinouchi T, Sakata K, Oishi M, et al. Benchmark dose of alcohol consumption for development of hyperuricemia in Japanese male workers: an 8-year cohort study. *Alcohol*. 2016;56:9–14. doi:10.1016/j.alcohol.2016.08.002
39. Yamanaka H. Alcohol ingestion and hyperuricemia. *Nihon Rinsho*. 1996;54(12):3369–3373.
40. Gu J, Ming X. Perceived social discrimination, socioeconomic status, and alcohol consumption among Chinese adults: a nationally representative study. *Int J Environ Res Public Health*. 2020;17(17):6043. doi:10.3390/ijerph17176043
41. Roth M, Timmermann BN, Hagenbuch B. Interactions of green tea catechins with organic anion-transporting polypeptides. *Drug Metab Dispos*. 2011;39(5):920–926. doi:10.1124/dmd.110.036640
42. Liu N, Wang L, Yang T, et al. EGF receptor inhibition alleviates hyperuricemic nephropathy. *J Am Soc Nephrol*. 2015;26(11):2716–2729. doi:10.1681/ASN.2014080793
43. Chen Y, Luo L, Hu S, et al. The chemistry, processing, and preclinical anti-hyperuricemia potential of tea: a comprehensive review. *Crit Rev Food Sci Nutr*. 2022:1–26. PMID: 35236179. doi:10.1080/10408398.2022.2040417
44. Piao W, Zhao L, Yang Y, et al. The prevalence of hyperuricemia and its correlates among adults in China: results from CNHS 2015–2017. *Nutrients*. 2022;14(19):4095. PMID: 36235748; PMCID: PMC9573360. doi:10.3390/nu14194095